

2001

-01 Consequences of Imaging



Program & Abstracts

PACS

Joint Meeting
4th Symposium Japanese-Scandinavian Radiological Society
and 7th Nordic-Japan PACS Symposium
Oslo, Norway, May 24-26, 2001

JAPANESE-SCANDINAVIAN RADIOLOGICAL SOCIETY

President, Japanese Side: Tatsuo Kumazaki, Tokyo

President, Scandinavian Side: Frode Lærum, Oslo

Honorary Meeting Presidents:

Ivar Enge, Lillehammer (N)

Takahiro Kozuka, Osaka (J)

Local Organising Committee

Meeting President: Frode Lærum

Secretary: Per Kristian Hol

Andreas Abildgaard

Morten Stiris

Olaug Råd

Junro Hosaka (special liaison to Japan for local committee)

Scientific Committee


Tatsuo Kumazaki (J)

Masayoshi Akisada (J)

Hans Ringertz (S)

Masao Sako (J)

Niilo Saranummi (Fin)

Kiyonari Inamura (J) 

Holger Pettersson (S)

Tetsuo Okabe (J)

Martti Kormanen (Fin)

Chikasumi Kuroda (J)

Alf Kolbenstvedt (N)

Takaaki Hosoya (J)

Finn Mathiesen (Dk)

Junro Hosaka (J)

Erik Fosse (N)

Silas Olsson (S)

Asbjörn Nordby (N)

Uno Eriksson (S)

Thorgeir Pálsson (ISL)

Jarl Å. Jakobsen (N)

Frode Lærum (N)

D2 大.羽.山
D4 12.佑.厚.
M2 日 止
M1 石 雄. 瑛 (C)

Sponsors:

Japan-Scandinavia Sasakawa Foundation

Nycomed Amersham Inc.

Fuji Medical Systems

Real World DICOM IHE

IHE can match the real world to DICOM, but

SCIENTIFIC PROGRAM they do not design

Friday 25 May 2001

information systems

09:00 - 09:30 Opening Session.

09:30 - 10:30 Session 1. Plenary lectures.

Chairs: T. Kozuka (J), I. Enge (N)

09:30 Honorary lecture.

Experiences with the first Interventional Centre in Japan.

T. Kumazaki, Tokyo, Japan

10:00 Invited lecture.

Data models in radiology information systems: Matching the real world to the DICOM standard.

A. Abildgaard, Oslo, Norway

MD

10:30 - 10:45 Coffee Break

10:45 - 12:45 Session 2. Plenary. Free papers.

Chairs: T. Okabe (J), J. Å. Jakobsen (N)

PACS

10:45 1. HOW TO MAKE A PACS PROJECT A SUCCESSFUL STORY

Jaakko Kinnunen, Hanna Pohjonen.

Hospital District of Helsinki and Uusimaa; Helsinki University Hospital; Radiology; Meilahti Hospital; POB 610; FIN-00029 HUS, Finland

10:57 2. DEVELOPMENT OF DEPARTMENTAL RIS/PACS COMBINED WITH A HOSPITAL-WIDE PACS; DICOM AND WEB-BASED SYSTEM

K. Miyasaka, S. Terae, T. Nambu, K. Kudoh, Y. Watanabe, T. Tsuzuki.

Department of Radiology, Hokkaido University Graduated School of Medicine and Univeristy Hospital, Sapporo, Japan

11:09 3. TELERADIOLOGY - LOGISTICS, SECURITY AND AUTHENTICATION ISSUES

O. Råd¹, A. Abildgaard².

Departments of ¹IT and ²Radiology, Rikshospitalet, University of Oslo, Norway

11:21 4. EVALUATION OF THE RADIOLOGISTS DIGITAL WORKING ENVIRONMENT

Hans Ringertz.

Department of Radiology, Karolinska hospital, Stockholm, Sweden

11:33 5. IMPLEMENTATION OF NETWORK TECHNOLOGIES IN HEALTH CARE

Margunn Aanestad.

The Interventional Centre, Rikshospitalet and Department of Informatics, University of Oslo, Norway.

11:45 - 11:55 Break

11:55 6. GENERALIZATION OF METHOD OF CLINICAL EVALUATION OF HIS/RIS

Kiyonari Inamura¹, Hideyuki Takeshita¹, Yasuhiko Okura¹, Michihiro Sasagaki², Hideaki Yoshimura², Yasushi Matsumura³, Hiroshi Takeda³.

¹School of Allied Health Sciences, Faculty of Medicine Osaka University, ²Department of Radiology, Osaka University Medical School and ³Department of Medical Information Science, Osaka University Hospital, Osaka, Japan

- 12:07 7. **QUANTITATIVE CLINICAL EVALUATION OF COMPRESSED MOTION IMAGE BY MPEG-2 FOR DIGITAL CINE ANGIOGRAPHY**
Y. Okura¹, Y. Matsumura², K. Hidaka¹, K. Inamura³, H. Yokoyama⁴, H. Inada⁵.
¹Graduate School of Medicine, Course of Health Sciences, Osaka University, ²Department of Medical Information Sciences, Osaka University Hospital, ³School of Allied Health Sciences, Faculty of medicine, Osaka University, ⁴Department of Radiology, National Cardiovascular Center, Osaka, Japan, ⁵Graduate School of Technology, The University of Tokyo, Hongo, Japan

- 12:19 8. **THE DESIGN OF TIME-ORIENTED DATA WAREHOUSE BASED ON THE MEDICAL INFORMATION EVENT MODEL**
Yuichiro Yamamoto¹, Hirokazu Namikawa², Kiyonari Inamura³.
¹Osaka University, Graduate School of Medicine, Course of Health Science, ²NEC Software Kansai and ³Osaka University, Faculty of Medicine, Osaka, Japan

- 12:31 9. **COMPARISON OF HARD AND SOFT-COPY CONFERENCE IN INTENSIVE CARE**
Marianne Maass, Marjatta Kosonen and Martti Kormanen.
Department of Diagnostic Radiology, University of Turku and Turku University Central Hospital, Turku, Finland

12:45 - 13:45 **Lunch**

13:45 - 15:30 **Session 3. Plenary. Free papers.**
Chairs: H. Tajima (J), K. Solheim (N)

Radiology

- 13:45 10. **ACUTE MASSIVE PULMONARY THROMBOEMBOLISM: A COMBINED APPROACH WITH MECHANICAL FRAGMENTATION USING A ROTATING PIGTAIL CATHETER, LOCAL FIBRINOLYSIS, AND CLOT ASPIRATION.**
Hiroyuki Tajima¹, Tatsuo Kumazaki¹, Satoru Murata¹, Kazuo Ichikawa¹, Pascal Niggemann¹, Ken Nakazawa¹, Madoka Nakahara¹, Junro Hosaka¹, Morimasa Takayama², Keiji Tanaka², Teruo Takano².

Departments of ¹Radiology and ²Internal Medicine, Nippon Medical School, Tokyo, Japan

- 13:57 11. **MAGNETIC RESONANCE GUIDED BIOPSY OF MUSCULOSKELETAL LESIONS ON A 0.23 T OPEN MR IMAGER**
R.K. Parkkola¹, K.T. Mattila¹, J.T. Heikkilä², T.O. Ekfors³, M.A. Kallajoki³, M.E.S. Komu¹, T.J. Vaara⁴, H.T. Aro².
Departments of ¹Radiology, ²Surgery and ³Pathology of Turku University Hospital, Kiinamyllynkatu 4-8, FIN-20520 Turku, and ⁴Marconi Medical Systems Finland, Inc., Äyritie 4, FIN-01510 Vantaa, Finland

- 14:09 12. **REALISM IN SIMULATORS FOR ROBOTIC SURGERY**
Jan Sigurd Rotnes.
The Interventional Centre, Rikshospitalet, Oslo, Norway

- 14:21 13. **A HYBRID TECHNIQUE FOR PERCUTANEOUS RADIOFREQUENCY THERMAL ABLATION OF OSTEIOD OSTEOMAS: CONCEPT, TECHNIQUE, AND RESULTS**
M. Hauser¹, I Lloret¹, S Skjeldal².
Departments of ¹Radiology and ²Surgery, Norwegian Radium Hospital, Oslo, Norway

- 14:33 14. **THE POSTERIOR PARAVERTEBRAL APPROACH FOR CT FLUOROSCOPY-GUIDED MEDIASTINAL BIOPSIES: A SAFE ACCESS ALSO TO THE MIDDLE MEDIASTINUM**
M. Hauser¹, PÅ Wolff¹, HM Olerud^{2,3}.
Departments of ¹Radiology and ²Medical Physics and Technique, The Norwegian Radium Hospital, Oslo, Norway; and ³Norwegian Radiation Protection Authority, Østerås, Norway

14:45 - 15:00 **Coffee Break**

10:10 - 10:25 *Coffe Break*

10:25 - 11:40 *Session 7. Parallel. Free papers. "Store Auditorium"*
Chairs: K. Miyasaki (J), M. Kormanio (F)

10:25 21. **QUALITY CONTROL OF IMAGE MONITORS IN PACS**

Aaro Kiuru.

Turku University Central Hospital (TUCH), 20520 Turku, Finland

10:37 22. **PERFORMANCE OF GENERAL PURPOSE COLOR MONITORS OF PACS IN THE WARDS**

H. Kondoh, H. Nishitani.

Department of Medical Information Science, Tokushima University Medical Hospital, Tokushima, Japan.

10:49 23. **VENOGRAPHY: COMPUTED RADIOGRAPHY (CR) V.S. FILM-SCREEN SYSTEM**

Junro Hosaka, Tatsuo Kumazaki, Hiroyuki Tajima, Satoru Murata, Madoka Nakahara, Ken Nakazawa.

Department of Radiology and High-tech Research Center, Nippon Medical School, 1-1-5 Sendagi, Bunkyo-ku, Tokyo, 113-8603, Japan

11:01 24. **CHANGING RADIOLOGICAL WORK PRACTICES**

Margunn Aanestad.

The Interventional Centre, Rikshospitalet and Dept. of Informatics, University of Oslo, Norway.

11:13 25. **CHARACTERISTICS OF RADIOLOGICAL IMAGE VIEWING PROGRAMS**

Markku Iivanainen.

University of Turku, Diagnostic Radiology, Turku, Finland

11:25 26. **ARCHITECTURE OF HUSpacs and HUSnet**

Hanna Pohjonen, Risto Laakkonen and Jaakko Kinnunen

Hospital District of Helsinki and Uusimaa; Helsinki University Hospital; Radiology; Meilahti Hospital; POB 610; FIN-00029 HUS, Finland

10:25 - 11:40 *Session 8. Parallel. Free papers. "Grønt Auditorium"*
Chairs: K. Inamura (J), M. Stiris (N)

10:25 27. **THE DEVELOPMENT OF COMPUTER PROGRAM FOR THE LONG-TERM PROGNOSTIC ANALYSIS OF LARYNX CANCER TREATED WITH RADIOTHERAPY AND SURGERY**

Y. Ohno¹, H. Sugiyama¹, S. Kasahara¹, A. Oshima², H. Tsukuma², W. Ajiki².

¹School of Allied Health Sciences, Osaka University, ²Osaka Medical Center for Cancer and Cardiovascular Diseases, Osaka, Japan

10:37 28. **DIAGNOSING LUNG VENTILATION and PERFUSION DISORDERS**

Aaro Kiuru, Erkki Svedström.

Turku University Central Hospital, 20520 Turku, Finland

10:49 29. **ON-TABLE ANGIOGRAPHIC FINDINGS IN OFF-PUMP CORONARY BYPASS SURGERY, AND ITS USEFULNESS AS PREDICTOR FOR LATE PATENCY OUTCOME.**

Per Kristian Hol¹, Erik Fosse¹, Runar Lundblad², Sigurd Nitter-Hauge³, Karleif Vatne⁴, Hans-Jørgen Smith⁴. ¹The Interventional Centre, ²Department of Thoracic Surgery, ³Department of Cardiology, ⁴Department of Radiology, Rikshospitalet, University of Oslo, Oslo, Norway

11:01 30. **DEVELOPMENT OF THE SYSTEM WHICH AUTOMATICALLY ACQUIRE OPTIMAL DISCRETE-VALUED ATTRIBUTE BY DIVIDING AND GROUPING CONTINUOUS-VALUED ATTRIBUTE TO ASSIST THE CLINICAL DECISION MAKING IN RADIOTHERAPY.**

H. Kou¹, H. Harauchi², K. Inamura².

¹Graduate School of Medicine, Course of Health Science and ²School of Allied Health Sciences, Faculty of Medicine, Osaka University

1.

HOW TO MAKE A PACS PROJECT A SUCCESSFUL STORY

Jaakko Kinnunen, Hanna Pohjonen.

Hospital District of Helsinki and Uusimaa; Helsinki University Hospital; Radiology; Meilahti Hospital; POB 610; FIN-00029 HUS, Finland

Objective: The PACS of the Hospital district of Helsinki and Uusimaa, HUSpacs, belongs to the most largest PACS installations in the world: altogether 800 000 examinations yearly stored digitally to the centralized database. The HUSpacs will be completed at the end of year 2003.

Material and methods: 1) Start in building a wide social contact network among the clinicians and the hospital's administration staff. 2) Make sure, that your basic infrastructure is OK: a high-speed redundant network, a radiological information system (RIS) steering the filmless imaging process, a digital scheduling system, digital imaging modalities supporting at least the most essential Dicom service classes. 3) In order to get support for your ideas make first a realistic business plan with expenditures and earnings and total revenues. Link the plan also to the organisation's mission, vision, values, goals and strategies. 4) After getting support for your ideas, proceed with a detailed implementation plan including a timeframe with milestones and short technical and clinical summaries. 5) Produce a short marketing movie of PACS and its benefits. 6) Get the support of the highest level of the organisation; make them feel themselves as driving forces in the project: invite them for members of the steering group of the project. 7) Choose one or two of your best radiographers for PACS maintenance tasks. 8) Organize a PACS project group comprising also key clinicians and IT-specialists of your own as well as those of the PACS-vendor. 9) Organize a PACS project group for every hospital: choose key clinicians for members as well. 10) Have at least one academic IT-specialist as a consultant and at least one IT-engineer from your own staff. 11) Benchmark all relevant PACS-sites. 12) When choosing the vendor, make sure, that you are going to get enough technical support. 13) In order to get the clinicians acceptance for the final big bang, promise them a 5-10% discount later. 14) Before the big bang test the system with single filmless days. 15) Make the radiologists and clinicians face the fact, that light boxes and auto-alternators disappear at one weekend.

Results and discussion: There are now two filmless hospitals in the district. The project schedule has been made even quicker and the board members accepted a remarkable amount of loan for the project. Rationalization benefits are clearly seen by radiologists and clinicians as well as politicians deciding on the financial resources.

2.

DEVELOPMENT OF DEPARTMENTAL RIS/PACS COMBINED WITH A HOSPITAL-WIDE PACS: DICOM AND WEB-BASED SYSTEM

K. Miyasaka, S. Terae, T. Nambu, K. Kudoh, Y. Watanabe, T. Tsuzuki.

Department of Radiology, Hokkaido University Graduated School of Medicine and Univeristy Hospital, Sapporo, Japan

Objectives: To maintain rapid transmission of images and smooth workflow, high-speed network and user-friendly terminals are mandatory. Recently, we implemented a PACS integrated with a Web-based RIS that spanned the entire works in the department. The system was combined with the hospital- wide HIS/PACS. We present the system regarding image data processing and management in radiology department.

Materials and Methods: All the digital imaging modalities (about 50), image workstations and RIS terminals were connected to Gigabit Ethernet switch. The image data were stored in multi-vendors servers with DICOM and with lossless compression. At the image workstations, the data were fetched from the DICOM servers by query/retrieval. RIS was constructed by Web-based resources and it comprised those of radiological ordering, examination booking, nursing support, accounting, reporting, drugs and materials, and so on.

Results: For 1.5 years duration, 150,000 examinations and 4,300,000 images (3.8TB) have been accumulated in the departmental DICOM servers. The data volume was almost the same as had been estimated before installation of the system; but CT data were 1.5 times larger than ones at estimation. CT and MR images were retrieved from the DICOM servers within 0.5 second/image. The images were interpreted exclusively on the workstations with 2-4 CRT monitors. Workflow including reservation of examination, ordering radiological examinations, reporting, exposure-data collection, transmission of nursing data was smooth by using Web-base RIS.

Conclusions: Softcopy diagnosis is accepted. Web-based RIS is suitable for management of works in radiology department.

3.

TELERRADIOLOGY - LOGISTICS, SECURITY AND AUTHENTICATION ISSUES

O. Råd¹, A. Abildgaard².

Departments of ¹IT and ²Radiology, Rikshospitalet, University of Oslo, Norway

Objective: Solutions for Teleradiology has been implemented in several of the Counties/Regions in Norway. Why are they accepted and actively in use at some sites and not in others? Having implemented PACS, at two sites, what are the requirements for implementing and utilising teleradiology between them - regarding logistics, standards, security and authentication?

Material and Methods: Interviews and discussions with users and usergroups at hospitals in Norway, both Technical and Medical staff. Literature/Standards: Dicom 3.0 and IHE Technical Framework.

Results and Conclusion:

Teleradiology solutions that are implemented in a separate network - not connected to local infrastructure at the sending and receiving hospital - are rarely used - though they are operative technically. *Regionsykehuset i Tromsø (RiTø)* are actively using their Teleradiology network for "remote reading". The success seems to be that the remote hospitals that are sending images to RiTø are sharing RIS with RiTø - then logistics for requests, booking, reporting and billing are taken care of in one system. Other hospitals successfully using teleradiology have organised multiple hospitals within one county as "one organisation", i.e. "one hospital" sharing the same Information systems and connecting them with high capacity network. What are the requests for implementing teleradiology between hospitals or sites that are not sharing RIS and PACS: 1. Use of common image-standards: DICOM Image Objects, 2. Common Radiology Report Standard - linked to images: No common accepted standard in use - DICOM Structured Reporting will be accepted? 3. Security in open networks: Dicom standard for Cryptation of dataset. 4. Authentication and Authorisation (ensure correct sender/receiver): Trusted third party. Identification/Password. 5. Ensure original image-set: Dicom std for coding of image-set. 6. Local DICOM nodes (local VLAN) are not allowed to use DICOM communication directly with remote DICOM nodes - due to security issues: Use of VLAN (DMZ) and Store and Forward Solutions are implemented at some sites. 7. Standard for requests - what shall be done with the images?: No solutions widely accepted. 8. Logistics must be taken care of: Registering what to do, billing, response, etc. at receiving site (local RIS). Remote image set connected with new images (patient has moved..) for comparison and planning, etc. (local PACS).

Final remark: Why are we pushing/sending data, creating unnecessary data traffic and information flow? - Modern technology trends: Notify (link) and pull/retrieve on demand.

4.

EVALUATION OF THE RADIOLOGISTS DIGITAL WORKING ENVIRONMENT

Hans Ringertz.

Department of Radiology, Karolinska hospital, Stockholm, Sweden

Objective: To evaluate the different steps in the radiologist work on a digital workstation with special reference to radiologist-specific and non-radiologist-specific steps. This includes scenarios with secretarial assistance and without.

Material/method: The time used by of one radiologist was analysed step by step during about 200 (1000 images) routine emergency radiology evaluations. The type of examination, log-in time, additional images, digital manipulations, calculations, dictation or writing were evaluated.

Results: At a continuous flow of examinations the radiologist spent 10 % of his time waiting, 13 % doing radiologist-specific work, 27 % doing what could/should have been done by the technician, and 50 % secretarial work. Working with a secretary increased the radiologist-specific time to 45 %.

Conclusion: The tasks of different personnel categories should be defined early and in detail in the digitalisation process. Incentives to maintain these definitions should be introduced. Thus optimise the diagnostic work for the radiologist.

5.

IMPLEMENTATION OF NETWORK TECHNOLOGIES IN HEALTH CARE

Margunn Aanestad.

The Interventional Centre, Rikshospitalet and Department of Informatics, University of Oslo, Norway.

Objective: Implementation of network technologies (e.g. PACS, telemedicine) in health care is challenging, and experience from other fields may provide relevant insight.

Materials and methods: Research results from studies of network technologies, of technology diffusion and on standardisation processes from the field of Information Systems Research is presented.

Results: There are fundamental differences between closed, local technologies (e.g. local systems at a department) and open, networking technologies (information infrastructures like telemedicine or multi-hospital PACS networks etc.). These differences require fundamentally new approaches to design and implementation. Network technologies are used to link together different actors (e.g. different institutions, different professional groups, experts and the public etc), who will have different agendas and interests. In such a network no single actor is in total control over the others, and traditional top-down decision-making must be replaced by enrolment strategies. Also a network will have to relate to the outside world and its ever-changing requirements which will inflict it (e.g. political regulations, technological development). As a network grows, its size and complexity will increase (its amount of and heterogeneity of actors, installed base), and it will be increasingly more difficult to change. Networks can only develop slowly, in an evolutionary manner, as radical changes are difficult/impossible. The change in strategy required to handle this kind of issues may be formulated as going from a "control paradigm" to a "cultivation paradigm".

Important corollaries of a "cultivation paradigm":

- Implementation should be viewed as a long-term, continuous negotiation process
- From a specification-focused to a prototype-oriented approach.
- Choose as flexible technology as possible (piecemeal changes, sub-networks, gateways).
- Standards are crucial and problematic. (The DICOM standard: universal intentions, but local utilisation).
- The importance of users' involvement in design, implementation and adaptation. Research emphasises the importance of the local "embedding work" when it comes to realising the potential.

Conclusion: Acknowledging the fundamental characteristics of networking technologies allow the challenges to be met from a different, and perhaps more realistic point of departure.

6.

GENERALIZATION OF METHOD OF CLINICAL EVALUATION OF HIS/RIS

Kiyonari Inamura¹, Hideyuki Takeshita¹, Yasuhiko Okura¹, Michihiro Sasagaki²,

Hideaki Yoshimura², Yasushi Matsumura³, Hiroshi Takeda³.

¹School of Allied Health Sciences, Faculty of Medicine Osaka University, ²Department of Radiology, Osaka University Medical School and ³Department of Medical Information Science, Osaka University Hospital, Osaka, Japan

Purpose: To establish generalized new method of clinical effectiveness of HIS/RIS, to compare it between pre/post operation of a system and between different systems, and to look for the timing of version up of the systems.

METHOD in case of HIS measurement: The total time for conversation (Tc), machine operation time (Tmo), machine operation time with conversation (Tmowc) was measured every year since 1995.

METHOD in case of RIS measurement: The reporting time (Tr) for radiological diagnosis and report writing time (Tw) by radiologists were measured. The number of characters (Nc) in a report of radiological diagnosis was counted. These measurements have been done every year since 1993.

RESULTS in case of HIS measurement: Tmo/Tc in internal medicine is about two times longer than that in orthopedics. And HIS effectiveness (Ieff) was calculated according to equation:

$$Ieff = Tmowc / Tmo \times (1 - Tmo / Tc)$$

HIS effectiveness in internal medicine had larger scores than that in orthopedics (1998: Ieff=0.152, 1999: 0.276), but had saturated in 1998 (Ieff= 0.389) and 1999 (Ieff= 0.386).

RESULTS in case of RIS measurement: After RIS operation, Tr has tended to be shortened slightly. And RIS effectiveness (Ieff) was calculated according to developed equation:

$$Ieff = Nc / Nco \times T_{2o} / T_{1o} / Tw / Tr \times Tw_{10o} / Tw_{10}$$

Tw₁₀ is time for writing 10 characters. And suffix o of each item is measured value of before RIS installation. Effectiveness was premature in just after the RIS installation (1994: Ieff= 0.63), but has been increased year by year since then. (1995: 1.16, 1996: 1.56, 1998: 2.02)

Conclusions: We proposed score functions and calculated effectiveness of HIS/RIS according to the result of measurements by time study in our hospital. Accordingly we determined timing to introduce new version of HIS and RIS to Osaka University Hospital. Our methodology will be applied for the same purpose, also in other hospitals as well.

7.

QUANTITATIVE CLINICAL EVALUATION OF COMPRESSED MOTION IMAGE BY MPEG-2 FOR DIGITAL CINE ANGIOGRAPHY

Y.Okura¹, Y.Matsumura², K.Hidaka¹, K.Inamura³, H.Yokoyama⁴, H.Inada⁵.

¹Graduate School of Medicine, Course of Health Sciences, Osaka University, ²Department of Medical Information Sciences, Osaka University Hospital, ³School of Allied Health Sciences, Faculty of medicine, Osaka University, ⁴Department of Radiology, National Cardiovascular Center, Osaka, Japan, ⁵Graduate School of Technology, The University of Tokyo, Hongo, Japan

Objective: To search optimized motion image compression ratio of MPEG-2 using subjective and objective evaluation method for digital coronary angiography.

Materials and Methods: Forty-four cases of motion image data of clinical cine digital angiography recorded on DICOM-CD were transferred to hard disk drive of PC with uncompressed file format. Coronary vessels in these angiography images had one or more stenosis. We compressed digital cine angiography image employing MPEG-2 encoder. Compression ratio was varied from 20 to 80.

First, we carried out subjective evaluation using AHA (American Heart Association) classification method. Three cardiologists in Osaka University classified the severity of stenosis in uncompressed images and compressed images to 7 categories according to AHA classification method using both still image and motion image on CRT. Viewing order was randomized. As statistical analysis, kappa-statistics were employed.

Second, we compared vessel stenosis ratio measured by quantitative cardiac analysis software. One still image for analysis was selected from each motion image. We measured vessel stenosis ratio and calculated correlation factor.

Results: In case of subjective evaluation employing AHA classification method, kappa statistics between two uncompressed images was higher than that between an uncompressed image and 1/80 compressed image. However, in case of compressed images to 1/20 and 1/40, kappa statistics were equivalent to that of uncompressed image. Correlation coefficient between two uncompressed images was 0.863. Only between uncompressed image and compressed image to 1/80 where correlation coefficient is 0.742, there was significant difference.

Conclusion: We conclude optimized compression ratio using MPEG-2 is 1/40. However, since these experiments are based on only coronary vessel stenosis, it is required to carry out research based on other diagnostic indexes.

8.

THE DESIGN OF TIME-ORIENTED DATA WAREHOUSE BASED ON THE MEDICAL INFORMATION EVENT MODEL

Yuichiro Yamamoto¹, Hirokazu Namikawa², Kiyonari Inamura³.

¹Osaka University, Graduate School of Medicine, Course of Health Science, ²NEC Software Kansai and ³Osaka University, Faculty of Medicine, Osaka, Japan

Objective: We propose a new medical information event model, Medical Information Event. Medical Information Event is a basic data unit which a medical information system handles.

On the other hand, a timing of treatment for a patient in medical information processing is sometimes very critical. So, we developed Time-oriented Data Warehouse which can provide a searching feature on the time axis using this model.

Material and Methods: We created the Medical Information Event from "PC-ORDERING2000". It uses UML(Unified Modeling Language) for the modeling of the event model, and defines the structure of the event model as DTD(Document Type Definition) of XML(eXtensive Markup Language).

Results: The Medical Information Event model turned to be consisted of unique and simple data structure. PC-ORDERING2000 which used Oracle had about 600 kinds of tables. However, we reduced these 600 kinds of complicated data structures to one kind of event model. Also, each event object exists in the system independently.

This simple and independent data structure contributed to make SQL transmission very fast. The Medical Information Event has a thread in two pieces of time, the valid time and the transaction time.

It satisfies the needs of a quick time search request of medical actions.

Conclusion: By our method of shifting the data of ordering system into the Medical Information Event, simple and flexible system design with easy secondary use of data was realized. A thread in two pieces of time and the Medical Information Event and the Time-oriented Data Warehouse were designed and developed successfully.

This newly proposed design method contributed to heighten the efficiency of data retrieval and to shorten response time to 1:600 at a terminal site, owing to 1:600 reduction of number of tables.

9.

COMPARISON OF HARD AND SOFT-COPY CONFERENCE IN INTENSIVE CARE

Marianne Maass, Marjatta Kosonen and Martti Kormano.

Department of Diagnostic Radiology, University of Turku and Turku University Central Hospital, Turku, Finland

Purpose: Filmless activity has been pursued since 1995 when a digital-linear tape archive was installed. Gradually the Medical Imaging Centre has been able to provide filmless services to the wards. The intensive care unit shifted to filmless operation in the beginning of 2001. Work processes related to hard-copy operation, transition period and filmless activity were compared.

Material and methods: An activity-based survey was conducted regarding traditional, transition and filmless operation. A dedicated person recorded the times regarding the working processes related to 134 conference cases.

Results: Preparation of conference by a clerk took 40-45 minutes either in the previous evening or in the morning prior to the conference. In the transition period conferences were prepared by a radiologist and a PACS expert in collaboration. In filmless operation conferences were prepared by a clerk with the assistance of a PACS software.

Conclusion: Work patterns changed and more expensive labour was used in the transition period. The total preparation time in filmless activity was shorter than with films but the time spent by radiologists was longer of that of the traditional activity. Quality of conferences was improved by the fact that availability of images ameliorated.

10.

ACUTE MASSIVE PULMONARY THROMBOEMBOLISM: A COMBINED APPROACH WITH MECHANICAL FRAGMENTATION USING A ROTATING PIGTAIL CATHETER, LOCAL FIBRINOLYSIS, AND CLOT ASPIRATION.

Hiroyuki Tajima¹, Tatsuo Kumazaki¹, Satoru Murata¹, Kazuo Ichikawa¹, Pascal Niggemann¹, Ken Nakazawa¹, Madoka Nakahara¹, Junro Hosaka¹, Morimasa Takayama², Keiji Tanaka², Teruo Takano².

Departments of ¹Radiology and ²Internal Medicine, Nippon Medical School, Tokyo, Japan

Objective: To evaluate the efficacy of mechanical fragmentation, local thrombolysis and clot aspiration in the treatment of acute massive pulmonary thromboembolism.

Materials and methods: Within 8 months, 10 hemodynamically impaired patients (two men, eight women; aged 56-78 years) were treated with thrombus fragmentation by mechanical action of rotating pigtail catheter. After embolus fragmentation, all patients recieved intrapulmonary injection of recombinant human-tissue plasminogen activator (rt PA), followed by clot aspiration using a large lumen PTCA catheter.

Results: All patients survived and their clinical status improved. Angiography in all patients post treatment demonstrated improvement of the pulmonary perfusion (mean Miller score; before treatment 21.4, after treatment 12.9). Mean pulmonary arterial pressure decreased from 30.3 mmHg to 20.5 mmHg ($p < 0.05$). Mean treatment time was 130.9 min.

Conclusion: Fragmentation by rotating pigtail catheter with local fibrinolysis and clot aspiration provided a rapid and safe improvement of the hemodynamic situation in massive pulmonary thromboembolism. The method appears useful especially in high risk patients threatened by right ventricular failure, and is a minimal invasive alternative to surgical embolectomy.

21.

QUALITY CONTROL OF IMAGE MONITORS IN PACS

Aaro Kiuru.

Turku University Central Hospital (TUCH), 20520 Turku, Finland

Objective: A great number of image work stations with one or two monitors are in use in TUCH when radiological images, today all digital except for mammography, are interpreted and viewed. Image monitors (and interpretation environment) are crucial components to create good platform for high quality radiological work in softcopies. They must be evaluated, calibrated and regularly assayed.

Methods and Results: Last year about 130.000 digital radiological examinations were made in TUCH. Until recent years image reporting has been made using hard copies e.g. films on viewing boxes. Now more and more image workstations are installed also to clinics and wards allowing softcopy diagnosing and viewing. Imaging services of the Turku City Hospital, at the moment under remodelling and digital re-equipment, were recently joined to TUCH implying 50 % increase in the number of examinations and of monitors and increasing image flow in the network. We are developing QA program for monitors and for evaluating other factors in workstation surroundings, which may strongly influence interpretation and viewing. First the SMPTE test image was used with a portable photometer (Hagner Universal Photometer) and later two commercial video display calibration systems (VeriLUM and Barco) to set up the baselines and make follow-up measurements of essential monitor characteristics such as linearity, distortions, focus sharpness, grey scale dynamics, spatial as well as (low and high) contrast resolution. A quick way to get monitor survey done is simply to look at the test image after proceeding tuning and/or calibration (e.g. against the standard DICOM-curve) of the monitor. A better and more consistent method is to perform measurements, store results into a database and follow slow changes of the parameters. The pros and cons of these methods will be discussed.

Conclusions: The 60 image workstations (today 47 in radiological, 13 in clinical use) and image analysing software consisting of 18 different user interfaces have been bought at different times and from different manufacturers. A multitude of monitor and software providers complicate interpretation and viewing work, but also quality control. Consequences will be discussed.

22.

PERFORMANCE OF GENERAL PURPOSE COLOR MONITORS OF PACS IN THE WARDS

H. Kondoh, H. Nishitani.

Department of Medical Information Science, Tokushima University Medical Hospital, Tokushima, Japan.

Objectives: The hospital-wide PACS usually uses general-purpose color monitor. But we are afraid the pitfall of maladjustment of monitors causes misunderstanding in the daily practice. The purpose is to clarify the response of luminance characteristics on general-purpose color monitors and to clarify users' behaviors on adjustment of monitors in the PACS.

Materials and Methods: Original standard image data was made to measure the luminance characteristics of monitors. It contained seventeen steps of gray levels. The luminance was measured by luminance meter (Bm-8, TOPCON Co. Japan). While the brightness and contrast setting were changed, the luminance characteristics of general-purpose color CRT and LCD monitors (NANA0 and Sony Co. Japan) and medical-purpose color CRT monitor (BARCO Co. Belgium) were measured. A PACS was installed in the wards of our hospital and physicians used in the daily practice. The adjustments in the wards were investigated.

Results: The general-purpose monitors had slightly linear characteristics. Higher contrast and lower brightness made the characteristic curve similar to medical-purpose color CRT monitor.

The CRTs in the ICU were adjusted to lower brightness to make the black area darker, because the room was not well lighted. LCD had different characteristics to CRT monitors and easily showed clippings on the brighter pixel values.

Conclusion: High brightness and high contrast setting made the maximum luminance brighter, but also made the minimum luminance brighter. In the darker room like ICU, brighter minimum luminance looked conspicuous and characteristic curve changed to linear. From our study, our general-purpose color CRT monitors should be set with high contrast and lower brightness.

The user's adjustment used clinical images and some objects in the image seemed to be estimated. If the brighter target and darker target were picked up appropriately, the adjustment seemed to be successful. Ideal standard digital images should be used at adjustment in spite of clinical image.

23.

VENOGRAPHY: COMPUTED RADIOGRAPHY (CR) V.S. FILM-SCREEN SYSTEM

Junro Hosaka, Tatsuo Kumazaki, Hiroyuki Tajima, Satoru Murata, Madoka Nakahara, Ken Nakazawa.

Department of Radiology and High-tech Research Center, Nippon Medical School, 1-1-5 Sendagi, Bunkyo-ku, Tokyo, 113-8603, Japan

Objectives: to determine the advantages of CR (with multi-objective frequency processing) as compared with film-screen system in venography.

Materials and methods: 18 legs from 18 patients who underwent venography for diagnosis of lower-limb varicose veins were included. For venography, each patients was placed supine on a fluoroscopic table with a head-up inclination of 30°. A total of 80-90ml of contrast material (Ioversol 320mgI/ml, Optiray®, Mallinckrodt) was injected into a dorsal pedal vein, and then radiograms of calf, knee, thigh and pelvic regions were obtained both by CR and by screen-film system. All images were scored from 1 to 3 (1, impossible; 2, difficult but possible; 3, easy) by 2 radiologists with respect to following parameters: detection of the iliac, femoral, greater saphenous (thigh, calf) veins, detection of the varicose veins and the perforating veins, and separation of the deep calf veins. Scores were expressed as a median and its 95% confidence interval of each method, respectively.

Results: for detection of the iliac, femoral, and greater saphenous (thigh) veins, no statistical difference was found between the scores of 2 methods. CR images were scored 3 (3-3) for the other parameters, while film-screen images were scored 2 (2-3) for detection of greater saphenous (calf) vein and 2 (1-2) for detection of varicose veins and the perforating veins and separation of the deep calf veins.

Conclusions: CR has been proved to be superior to film-screen system in venography and it may be useful for accurate diagnosis of venous diseases in lower extremity.

24.

CHANGING RADIOLOGICAL WORK PRACTICES

Margunn Aanestad.

The Interventional Centre, Rikshospitalet and Dept. of Informatics, University of Oslo, Norway.

Objective: The transition into a PACS environment, and the full utilisation of the technology is often problematic. The reason for this may be an insufficient attention to organisational issues of radiological work.

Materials and methods: Relevant research results from the field of qualitative Information Systems Research are presented. The focus within this field is the interrelationship between work practice and (new) technologies, and here the emphasis will be on studies from PACS implementation.

Results: Acknowledging the complexity of work is essential. Work must be seen as more than the formal organisation and the explicit routines and work tasks; the tacit or implicit elements are crucial as well. A given work practice can be viewed as a heterogeneous "ensemble" or "network" of e.g. people, formal organisation, explicit as well as implicit routines, and physical entities (things). Changing one of the elements also has implications for the rest of this "network". One example may illustrate this: A paper requisition or an analog film provides important resources for work. In addition to the obvious central resources (as information carriers) they also possess peripheral resources, e.g. capacity for coordination of work. This is partly a feature of their physicality; analog films on a light board or a stack of requisitions in a particular shelf may be seen by passers-by and give them an awareness of other radiologist's work. When the physical things are replaced with their digital counterparts, often these unnoticed but crucial, aspects are neglected, and work practice suffers as a result. Optimal efficiency is not achieved, a reportedly common result of PACS projects.

Conclusion: It is crucial to look beyond the obvious and visible aspects of radiological work, and to strive for a profound understanding of both the formal and tacit aspects. Only thus can the new technology be designed to provide new, and even more powerful and efficient resources to replace the old. And only thus can problems be avoided and the full potential of the PACS technology be exploited.

*overlooks
implicit elements of work*

25.

CHARACTERISTICS OF RADIOLOGICAL IMAGE VIEWING PROGRAMS

Markku Iivanainen.

University of Turku, Diagnostic Radiology, Turku, Finland

Objective: Client departments of radiology use dedicated image viewing programs to review softcopy images in a PACS environment. Nearly all major image acquisition equipment and medical program manufacturers offer programs with varying solutions for this purpose. We have studied the characteristics of several image viewing programs and tried to define an optimal image viewing program for client departments of radiology.

Materials and Methods: Two image viewing programs, Clinical Access 4.1 by Cemax-Icon, Kodak and PCView 2.1 beta by Jons Finland, have been reviewed in detail. Experience of several other similar systems has been included in trying to define an optimal image viewing program.

Results: An optimal image viewing system would consist of:

Hardware: a computer equipped with at least a Pentium 400 MHz class CPU, 128 MB memory, 10 GB hard drive, 21” display and videocard with properties of 1600 x 1200 x 24, 85 Hz, 16 MB.

Operating system: Windows 4.0 or better.

Server environment and workflow: A server-based system is preferable over standalone units. The installation and configuration of viewing programs should be done remotely and centralized.

Images should be indexed according to client departments with study lists automatically updated. Image viewing programs should be able to retrieve both exam requests and reports from a PACS broker.

Studies should open for comparison conveniently from the patient list and display window.

Image viewing tools include window level and width adjustment with presets, resize, rotate, flip, invert, zoom, sharpen and cine. Measuring tools include distance, angle, point value and ROI-statistics.

Conclusions: An optimal image viewing program would consist of the best qualities of the reviewed programs.

Centralized server and installation environment can be made possible by utilizing web technologies.

A prerequisite for a fluent workflow is a consistent division between studies, series and images throughout the entire imaging chain. Program manufactures would greatly benefit from a close co-operation with end-users by studying carefully the work pattern of doctors evaluating images. Consequences of non-optimal function of viewing programs will be described.

26.

ARCHITECTURE OF HUSpacs and HUSnet

Hanna Pohjonen, Risto Laakkonen and Jaakko Kinnunen

Hospital District of Helsinki and Uusimaa; Helsinki University Hospital; Radiology; Meilahti Hospital; POB 610; FIN-00029 HUS, Finland

1 million examinations / year

RAID HL7 standard eGate

authentication with smart cards

ATM #99

Objective: The PACS of the Hospital district of Helsinki and Uusimaa, HUSpacs, belongs to the most largest PACS installations in the world: altogether 800 000 examinations (20 TB) stored yearly to the centralized database. The HUSpacs will be completed at the end of year 2003.

Material and methods: The HUSpacs architecture is based on local short-term archives (RAID) in each radiological department and a centralized image database as well as long-term and back-up archiving. RIS/PACS-integration utilizes HL7 standard and two integration platforms. There is also a separate integration platform for routing of HL7 messages. Data security is specially paid attention to. Every user has his own unique user ID and a secret password and all user activities including the time and dates of the activities are logged. This does not only concern image transfer but also image alterations and searching criteria. According to Finnish legislation, the patient has the right to check who has used his patient information and what for. Patient permission is always needed when transferring data to another organisation. In the future, this permission will be stored in a reference database, which is a regional information system containing references to patient information that is stored in different organisational databases (patient information directory). Later this year user authentication will be performed using smart cards. Furthermore, instead of validating user logons against user profiles stored in the PACS database, we will utilise separate server containing all users, their roles and role profiles. In the future, radiological reports are also digitally signed using this smart card. Because of it's centralized nature HUSpacs requires a reliable and efficient network (HUSnet). The most important requirements for both the local and frame network are as follows: round-the-clock network control and management, redundant topology, high capacity as well as QoS (Quality of Service) and CoS (Class of service) properties. The frame network connecting the different campus areas is based on ATM-technology and all the critical servers are connected directly to the backbone switches. Each campus area has its own 40 or 155 Mbps connection with all physical links and active components doubled. The vendor of the frame network has committed to the usability of 99,98 % meaning about 1,7 hours down-time per year.

Results and discussion: There are now two filmless hospitals in the district. The benefits are clearly seen both in action and economically. The components of the regional architecture are planned this year. At the same time, there is a gradual connection of different hospitals into HUSpacs.

29.

ON-TABLE ANGIOGRAPHIC FINDINGS IN OFF-PUMP CORONARY BYPASS SURGERY, AND ITS USEFULNESS AS PREDICTOR FOR LATE PATENCY OUTCOME.

Per Kristian Hol¹, Erik Fosse¹, Runar Lundblad², Sigurd Nitter-Hauge³, Karleif Vatne⁴, Hans-Jørgen Smith⁴. ¹The Interventional Centre, ²Department of Thoracic Surgery, ³Department of Cardiology, ⁴Department of Radiology, Rikshospitalet, University of Oslo, Oslo, Norway

On-table angiographic examinations of the anastomoses is of importance in the quality assessment in off-pump coronary artery bypass surgery, although the technique has not been evaluated with follow-up studies.

Material: Selective coronary angiography was performed on-table in 45 patients, with a total of 57 grafts, undergoing off-pump coronary artery bypass surgery. Follow-up angiography was performed at 3 and 12 months postoperatively.

Results: The most frequent findings on-table was spasm, not present at the follow-up. At the on-table angiography there were 9 kinks, and only in one case a significant lesion appeared at three months. Forty-one grafts were on-table optimal at the site of the anastomoses, of these 5 developed significant stenoses; 3 grafts had minor stenoses which advanced to significant stenoses in 2, and 11 grafts had significant stenoses which disappeared at the follow-up in 8.

Conclusion: On-table angiography can be difficult to interpret as not all findings are of importance for later patency. Optimal results at the on-table angiography indicate good long-term results, since 88% remained patent at the follow-up. On the other hand significant stenoses at the site of anastomoses is less predictable since 73% were not present at the follow-up.

30.

DEVELOPMENT OF THE SYSTEM WHICH AUTOMATICALLY ACQUIRE OPTIMAL DISCRETE-VALUED ATTRIBUTE BY DIVIDING AND GROUPING CONTINUOUS-VALUED ATTRIBUTE TO ASSIST THE CLINICAL DECISION MAKING IN RADIOTHERAPY.

H.Kou¹, H.Harauchi², K.Inamura².

¹Graduate School of Medicine, Course of Health Science and ²School of Allied Health Sciences, Faculty of Medicine, Osaka University

Purpose: When we want to assist the clinical decision making on the methods or modalities of radiotherapy, we could use a clinical decision analysis. In the process of dealing discrete-valued attributes, we can select the optimal value of the therapy attribute. But in case of dealing a continuous valued attribute such as tumor dose, we have to select optimal value of the attribute from divided and grouped continuous-value attribute.

Then the purpose of this study is to develop the system which statistically test the results of radiotherapy and automatically acquire optimal discrete-valued attribute by dividing and grouping continuous-valued attribute to assist the clinical decision making.

Material and Methods: In this study, we have a database named Radiation Oncology Greater Area Database (ROGAD) which is the multi-institutional radiation oncology database in Japan.

The method of our development is as follows:

- 1) A data subset is divided into units which have discernible statistical significance in minimum number of cases. These units again make another data subsets called preliminary data subset such as tumor dose subset
- 2) This preliminary data subset is compared with adjacent data subset by a statistical test. And we know that two subsets are integrated into one subset or not.
- 3) By repeating above process 2), optimal discrete-valued attribute is found from continuous-valued attribute.

Results and Conclusion: After we finished above procedures by a sample database, resolution of discrete-valued attribute and speed of convergence was confirmed to be practical. Consequently we applied this method to real instances of clinical cases from the mother database ROGAD. Optimal discrete-valued attribute of tumor dose was found in the condition that a factor of pathological code was included to the primary response and survival term. The discernible optimal range of tumor dose was improved to be considerably good resolution of optimization.